CARGO TRAILER

FIELD OF THE INVENTION

[0001] The present invention relates generally to a trailer for carrying cargo and, more particularly, to a trailer that may carry cargo on a deck of the trailer that is adjustable to ease loading and unloading of the cargo from the trailer. The cargo trailer of the present invention is particularly suited for a cargo handling adverse terrain trailer (CHATT) for transporting cargo and loading cargo into a transport aircraft or the like, but may be equally suited for other applications as well.

BACKGROUND OF THE INVENTION

[0002] Trailers or vehicles for carrying cargo and for loading cargo into vehicles, such as aircraft and the like, are generally known. Such trailers typically have a platform that may be raised upward to position the platform at a loading portion of the vehicle or aircraft to ease loading of the cargo from the trailer to the aircraft. The trailers may be able to adjust the platform to maintain the platform relatively level at the raised position to support the cargo at the desired level at the vehicle. Typically, such trailers or cargo carriers have the cargo lifted upward from the ground and placed on the platform at the trailer prior to transporting the cargo, and then elevate the platform to the desired height at the targeted vehicle or aircraft. Examples of such trailers or vehicles are shown in U.S. Patent Nos. 3,666,127; 3,688,926; 3,944,096; 5,165,838; 5,630,694 and 6,447,044. Such trailers or vehicles often include multiple pivotable arms/linkages which pivot relative to one another and to the frame and platform of the trailer in order to provide the desired elevational adjustments to the trailer. Also, although such trailers or vehicles are often capable of transporting and elevating cargo to a desired elevated loading area, such as at an aircraft or the like, the cargo or articles must first be lifted upward onto the trailer platform, which is often cumbersome and difficult to accomplish, and sometimes requires a forklift or the like.

SUMMARY OF THE INVENTION

[0003] The present invention provides a trailer or vehicle for carrying cargo that may be readily loaded by moving the cargo onto the platform or deck of the trailer when it is tilted down toward the ground. The platform or deck of the trailer may be selectively raised or lowered or otherwise adjusted to provide a generally level platform or deck during transport of the cargo to the targeted vehicle or aircraft and during unloading of the cargo at an

elevated receiving portion of the vehicle or aircraft. The cargo trailer may comprise a cargo handling adverse terrain trailer (CHATT) for loading and unloading cargo containers from military transport aircraft and the like. The deck may be substantially universally adjustable to meet varying terrain conditions that the trailer may encounter.

[0004] According to an aspect of the present invention, a trailer for carrying cargo includes a frame portion, at least two axles mounted to a frame portion and a deck. Each of the axles includes at least one wheel at opposite ends of the axle, whereby the wheels and axles support the frame portion above the ground. The deck is pivotally mounted to the frame portion via first and second supports. The supports are independently operable or adjustable to raise and lower respective portions of the deck relative to the frame portion. The deck is pivotable about a first axis relative to the frame portion and about a second axis relative to the frame portion via the supports. The first axis extends generally longitudinally along the deck, while the second axis extends generally laterally across the deck and generally normal to the first axis. The deck is slidable generally along the first axis relative to the frame portion and/or the second support. For example, the deck may slide rearward and may be tilted about the second axis such that a rearward end of the deck may contact the ground.

[0005] According to another aspect of the present invention, a trailer for carrying cargo includes a frame portion, at least two axles mounted to the frame portion, and a deck. The axles include wheels at opposite ends of the axles, such that the wheels and axles support the frame portion of the ground. The deck is pivotally mounted to the frame portion by a boom member and at least one rear support. The boom member is pivotally connected to the frame portion and to the forward portion of the deck. The rear support is connected at a rear portion of a frame portion and at a rearward portion of the deck. The boom member is pivotable about a lateral axis extending generally laterally across the frame portion to vertically adjust the forward portion of the deck relative to the frame portion. The boom member pivots about the laterally extending axis via a first actuator attached to the frame portion and the boom member. The boom member extends and retracts to longitudinally adjust a position of the deck relative to the frame portion. The boom member is extendable and retractable via a second actuator positioned along at least a portion of the boom member.

[0006] The boom member may be attached to the forward portion of the deck via a multi-axis connection that facilitates pivotal movement of the forward portion of the deck about at least two axes. The deck thus may pivot relative to the boom member and the frame portion about both a longitudinal pivot axis extending generally longitudinally along the deck and the laterally extending pivot axis. The boom member may comprise a telescopic boom member

that may extend and retract to longitudinally adjust the position of the deck relative to the frame portion.

[0007] According to another aspect of the present invention, a trailer for carrying cargo includes a frame portion, at least two axles mounted to the frame portion and a deck. The axles include wheels at opposite ends of the axles, such that the wheels and axles support the frame portion above the ground. The deck is pivotally mounted to the frame portion and is pivotable about a longitudinal axis relative to the frame portion. The longitudinal axis extends generally longitudinally along the deck, while the lateral axis extends generally laterally across the deck and generally normal to the longitudinal axis. A rearward portion of the deck is attached to a pair of rearward supports, which are attached to a rearward portion of the frame portion at respective and opposite sides of the centerline of the frame portion. The rearward supports are pivotable relative to the frame portion about a laterally extending axis at the frame portion. The rearward supports pivot to vertically adjust the rearward portion of the deck relative to the frame portion. The rearward supports are independently extendable and retractable to pivot the deck about the longitudinal axis.

[0008] The deck may be slidably attached to the rearward supports, such that the rearward supports may slide along the deck as the rearward supports are pivoted about the laterally extending axis at the frame portion. The deck may be attached to an extendable and retractable boom member that extends and retracts to slide the deck relative to the rearward supports and the frame portion. The rearward supports may be pivotable about the laterally extending axis of the frame to move the rearward portion of the deck rearwardly relative to the frame portion and to lower the rearward portion of the deck downward toward and into contact with the ground and rearward from the frame portion.

[0009] According to another aspect of the present invention, a trailer for carrying cargo includes a frame portion, a deck attached to the frame portion, front and rear axles mounted to the frame portion, and a hitching member for connecting the trailer to a towing vehicle. Each of the axles includes at least one wheel at opposite ends of the axle, such that the wheels and axles support the frame portion above the ground. The front axle comprises a steerable axle and is mounted to an axle base that is pivotally attached to the frame and that is pivotable about a first generally vertical axis to turn the front axle relative to the frame portion to steer the trailer. A hitching member is pivotally attached to a front portion of the frame portion and is pivotable about a second generally vertical axis that is spaced from and forward of the first axis. The hitching member is movably engaged with or connected to the

axle base forward of the second axis, such that pivotal movement of the hitching member about the second axis causes pivotal movement of the axle base about the first axis.

[0010] The hitching member may be movably engaged with the axle base via a mounting member of the hitching member extending through a slot in the axle base. The mounting member may urge the axle base to pivot and may move along the slot when the hitching member pivots about the second axis and while the axle base pivots about the first axis. The hitching member may be pivotable about the second axis via at least one actuator connected between the hitching member and the frame portion. The hitching member may be vertically adjustable to adjust a hitching end of the hitching member relative to the frame portion.

[0011] Optionally, the rear axle assembly may comprise a steerable rear axle assembly that is pivotable about a third generally vertical axis to steer or turn a rear portion of the trailer. The rear wheels or the rear axle may pivot in a second direction in response to the front axle pivoting in a first direction, with the second direction being generally opposite to the first direction. The rear wheels or the rear axle may be connected to the front axle via at least one connecting member or linkage, whereby the connecting member may urge the rear axle or rear wheels to pivot in the second direction when the front axle pivots in the first direction.

[0012] Optionally, the cargo trailer may include at least one center axle and wheels positioned between the front and rear axles. The front, rear and center axles may be vertically adjustable relative to the frame portion. The center axle or axles may be selectively raisable relative to the frame portion and relative to the front and rear axles, so that the frame portion is supported substantially or only by the wheels of the front and rear axles. Alternately, the front and rear axles may be selectively raisable relative to the frame portion and the center axle, such that the frame portion is supported substantially or only by the wheels of the center axle or axles.

[0013] Therefore, the present invention provides a cargo handling adverse terrain trailer for transporting cargo which may be readily loaded with cargo and which may be readily unloaded at a desired or targeted vehicle, such as an aircraft or the like. The deck of the trailer may be moved rearwardly and tilted downwardly toward the ground to ease loading of the trailer. When the trailer has been positioned at or near the desired unloading area, such as at an elevated loading or receiving portion of an aircraft or the like, the deck may be raised upwardly to position the cargo generally at the level of the loading area to ease unloading of the cargo from the trailer and loading of the cargo into the aircraft. The deck may be tilted or angled to one side or the other relative to the frame of the trailer to facilitate leveling of the deck at the aircraft or the like. The trailer may be steerable to ease maneuverability of the

trailer between the loading and unloading areas and may have wheels that are selectively lowered into engagement with the ground to adapt the trailer to different terrains and driving conditions.

[0014] These and other objects, advantages, purposes and features of the present invention will become more apparent upon review of the following specification in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] FIG. 1 is a side elevation of a cargo trailer in accordance with the present invention, with a deck of the trailer in an elevated position;

[0016] FIG. 2 is a front end elevation of the cargo trailer of FIG. 1;

[0017] FIG. 3 is a top plan view of the cargo trailer of FIGS. 1 and 2;

[0018] FIG. 4 is a lower plan view of the cargo trailer of FIGS. 1-3;

[0019] FIG. 5 is a perspective underside view of a rear portion of the cargo trailer, showing a pair of rear supports that support the deck above the frame of the cargo trailer;

[0020] FIG. 6 is a perspective view of a rear portion of the cargo trailer showing the pivotal mounting of the boom to the frame, and with the frame and wheels shown in phantom;

[0021] FIG. 7 is a perspective view of the rear portion similar to FIG. 6, with the frame and wheels removed to show additional details;

[0022] FIG. 8 is a side elevation of the cargo trailer similar to FIG. 1, with a forward platform of the deck being angled upwardly;

[0023] FIG. 9 is another side elevation of the cargo trailer similar to FIG. 8, with the deck in its lowered orientation;

[0024] FIG. 10 is a front end elevation of the cargo trailer of FIG. 9;

[0025] FIG. 11 is a front end elevation of the cargo trailer similar to FIG. 10, but with the deck in its raised orientation;

[0026] FIG. 12 is a sectional view of the cargo trailer generally along the line XII-XII in FIG. 11;

[0027] FIG. 13 is a perspective sectional view of the cargo trailer, also taken along the line XII-XII in FIG. 11;

[0028] FIG. 14 is an enlarged perspective sectional view similar to FIG. 13;

[0029] FIG. 15 is a sectional view of the cargo trailer taken generally along the line XV-XV in FIG. 11;

[0030] FIG. 16 is an enlarged sectional view of the rear portion of the trailer of FIG. 15;

[0031] FIG. 17 is a perspective sectional view of the cargo trailer, also taken along the line XV-XV in FIG. 11;

[0032] FIG. 18 is an enlarged perspective sectional view of the rear portion of the cargo trailer of FIG. 17;

[0033] FIG. 19 is a side elevation of the cargo trailer, similar to FIG. 1, with the deck angled downward to the ground for loading of the cargo trailer;

[0034] FIG. 20 is a side elevation of the cargo trailer, with the deck tilted toward the left side of the trailer;

[0035] FIG. 21 is a rear elevation of the cargo trailer of FIG. 20;

[0036] FIG. 22 is a side elevation of the cargo trailer, with the deck titled toward the right side of the trailer;

[0037] FIG. 23 is a rear elevation of the cargo trailer of FIG. 22;

[0038] FIG. 24 is a side elevation of the cargo trailer, with the deck tilted toward the left side of the trailer;

[0039] FIG. 25 is a front elevation of the cargo trailer of FIG. 24;

[0040] FIG. 26 is a perspective view of the frame and axles and hitching assembly of the cargo trailer of the present invention;

[0041] FIG. 27 is a perspective view of the cargo trailer of FIG. 26, showing the steering mechanism of the cargo trailer;

[0042] FIG. 28 is an underside perspective view of the front end portion of the cargo trailer of the present invention; and

[0043] FIG. 29 is a schematic of the cargo trailer of the present invention, showing the turning radius of the cargo trailer of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0044] Referring now to the drawings and the illustrative embodiments depicted therein, a cargo trailer 10 includes a frame or frame portion 12 and a deck or deck portion 14 pivotally and adjustably mounted to frame 12. Frame 12 may be supported above the ground via a plurality of tires 16a on wheels 16b on axles 19 of multiple axle assemblies 18. Cargo trailer 10 may receive or support cargo on deck 14 and may pivot or tilt downwardly to the ground to load the cargo onto the deck 14, such as shown in FIG. 17 and discussed below. Deck 14 may also be raised upwardly above frame 12 (as shown in FIGS. 1-8) to generally align deck 14 with an unloading portion of a targeted vehicle or the like, such as a cargo bay of an aircraft 20 (FIG. 2) or the like, as also discussed below.

[0045] The cargo trailer of the present invention and aspects thereof are particularly suited for a cargo handling adverse terrain trailer (CHATT) for loading and unloading cargo containers from military transport aircraft and the like. For example, the trailer may be towed by a vehicle 11 (FIG. 27), such as a military vehicle, such as a heavy expanded mobility tactical truck (HEMTT) or the like, or by other types of towing vehicles, without affecting the scope of the present invention. Although shown and described as a trailer that is towable behind a driven vehicle, it is envisioned that aspects of the present invention are suitable for application to cargo carrying vehicles, such as trucks and the like that have a cargo carrying bed or platform or deck. The term "trailer" as used herein is not intended to be limited only to towable, non-driven trailers, but is intended to cover such vehicles with cargo carrying beds or decks attached thereto.

[0046] The deck of the trailer may be universally adjustable relative to the frame to meet varying terrain conditions that the trailer may encounter. The deck is substantially universally adjustable via a three-point connection of the deck to a front lift boom and a pair of rear lifts or supports, as discussed below. The three-point connection includes a multi-axis or substantially universal connection to the forward end of the lift boom and to the pair of lift arms or supports. The rear supports may be pivoted together relative to the frame and may be independently extended and retracted to adjust or tilt the deck toward one side or the other as allowed by the universal connections or joints at the ends of the lift arms and at the end of the boom. Each of the lift arms may be slidably connected to the underside of the deck by means of slide members and rails or tracks, so that as the lift boom is extended or retracted, the deck may slide forwardly or rearwardly on the slide members irrespective of the tilt of the trailer bed. The deck may be adjustable relative to the frame about either of the axes or may be adjusted along its longitudinal axis irrespective of the degree of tilt about either of the axes and of the position of the deck along the longitudinal axis relative to the frame.

[0047] As shown in FIG. 26, frame or frame portion 12 of cargo trailer 10 may include a pair of longitudinal frame members 22 and multiple cross members 24 extending across and between and connecting longitudinal frame members 22 to define a generally rectangular frame portion. Frame 12 may include an extendable stabilizer 26 generally at each of the corners of the trailer to provide support and stability to the trailer when stabilizers 26 are extended or lowered into engagement with the ground. Stabilizers 26 may be extended or lowered via any known means, such as hydraulic cylinders or actuators or the like, without affecting the scope of the present invention.

[0048] The axle assemblies 18 may be mounted to the underside of frame 12. Axle assemblies 18 may comprise a front axle assembly 18a, a rear axle assembly 18b and one or more center axle assemblies 18c spaced along frame 12 to provide support of frame 12 and deck 14 above the ground. As discussed below, the front and rear axle assemblies 18a, 18b may be steerable or adjustable to steer the trailer 10. As also discussed below, the axle assemblies 18a, 18b, 18c may optionally be vertically adjustable relative to frame 12 and relative to one another, such that one or more of the axle assemblies may be raised above the ground while the other axle assemblies support the frame above the ground.

[0049] Deck or deck portion 14 of trailer 10 is adjustably mounted to frame 12 and is adjustable relative thereto. Deck 14 provides a generally flat support surface 14a for supporting cargo and the like on cargo trailer 10. Deck 14 may include a main deck portion 14b and a pivotable platform 28 that is pivotally mounted at a forward end 14c of main deck portion 14b to ease unloading of cargo and articles off of deck 14 and into a targeted vehicle or aircraft at which the front end of the trailer may be positioned. Platform 28 may be pivoted about a generally horizontal or laterally extending axis 28a (FIG. 15) relative to main deck portion 14b, and may be pivotable between a generally aligned orientation (as shown in FIG. 1) and an upwardly angled orientation (as shown in FIG. 8) via an actuator 30 (FIG. 15), such as a hydraulic cylinder or the like. Optionally, the forward platform of the cargo trailer may be extendable and retractable relative to the main deck portion to position the forward platform at a desired loading or unloading area, without affecting the scope of the present invention. A rear portion 14d of main deck portion 14b may include an angled or ramped end portion 15, which may be formed or configured or adapted to engage the ground and to provide a ramp at the ground when the deck 14 is tilted rearwardly and downwardly (as shown in FIG. 19) for loading of the cargo trailer, as discussed below.

[0050] Deck 14 may include one or more conveying members or bands or belts or chains 32 for conveying articles or cargo along the support surface 14a of deck 14. The conveyor belts or chains 32 may be reeved around pulleys or sprockets 34a, 34b at opposite ends 14c, 14d of main deck portion 14b, as shown in FIGS. 3, 13, 14 and 17. Platform 28 may also include one or more conveyor belts or bands or tracks 33 or the like routed or reeved around the forward pulley or roller 34a of main deck portion 14b and further around a forward pulley 34c of platform 28. The rollers or pulleys 34a, 34b, 34c may be selectively rotated to drive the conveyor belts 32, 33 to move articles along deck 14 of trailer 10, and the rollers may be rotated or the belts moved or driven via any driving means, without affecting the scope of the present invention. For example, and as shown in FIGS. 19-25, one or more hydraulic motors

35 may be mounted to deck 14 and connected to the rear pulleys 34b of deck 14 to rotatably drive the pulleys to convey objects along the deck surface 14a.

[0051] Although shown and described as having conveyor belts along the deck and platform, other means for moving and/or controlling movement of articles or objects or cargo on the deck and platform may be implemented, without affecting the scope of the present invention. For example, the deck may include a plurality of ball transfers to allow movement of the cargo containers in virtually any direction on the deck. Each of the ball transfers may be mounted on a plate under the main deck. The supporting plate may be raised or lowered by appropriate means (such as pneumatic or hydraulic means) such that when the plate is raised, the ball transfers contact the bottoms of the cargo containers to allow movement of the containers in virtually any direction. Appropriate drive rollers may also be included to move the cargo containers when supported on the ball transfers. When the supporting plate is lowered, the cargo containers will rest against the deck to resist movement along the deck.

[0052] In the illustrated embodiment, deck 14 includes a forward bracket 36 at or near the forward end 14c of the main deck portion 14b for pivotally mounting the forward portion of the deck to a lift boom or boom member 38. Boom 38 is extendable and retractable to move deck 14 longitudinally relative to frame 12, and is pivotable relative to frame 12 and to bracket 36 to vertically adjust the forward end portion of deck 14, as discussed below. The rear portion of deck 14 may be slidably supported by a pair of rearward supports 40, which may pivot or tilt the rear portion or end 14d of deck 14. As best seen in FIGS. 2 and 5, deck 14 may include a pair of lower rails 42, which may be slidably received within sliding members 44 at the upper ends of the rearward supports 40, such that deck 14 may be slidably mounted to the upper ends of the rearward supports 40, as discussed below. Deck 14 thus may be longitudinally movable relative to frame 12 by extension and retraction of boom 38, whereby the deck 14 may slide along the slide members 44 while being supported by the rearward supports 40. The rear supports may be pivotally mounted at a rearward portion of frame 12, and may be pivotable to raise and lower and tilt the rear portion of deck 14, as also discussed below.

[0053] Boom 38 may comprise a telescopic boom member that includes a lower or outer member 46a and an upper or inner member 46b, which are extendable and retractable relative to outer member 46a. In the illustrated embodiment, outer member 46a is attached to a pivot axle 47, which is pivotally mounted to the rearward portion of frame 12. Outer member 46a slidably receives inner member 46b therein. Inner member 46b is pivotally attached at its opposite or outer end to bracket 36 of deck 14 to support the forward end of deck 14. Inner

member 46b may be extendable and retractable relative to outer member 46a via an actuator 48 (FIGS. 12-14) positioned at least partially along and within boom 38. Boom 38 may include a support roller 49 for rollingly supporting the inner boom member 46b as it is extended and retracted relative to the outer boom member 46a.

[0054] Inner or upper member 46b of boom 38 is pivotally attached to bracket 36 of deck 14 via a multi-axis or universal attachment 50, which allows for pivotal movement of deck 14 relative to boom 38 about a generally laterally extending axis 51a (FIG. 2) and about a generally longitudinally extending axis 51b (FIG. 3) to allow for tilting or angling of deck 14 relative to frame portion 12 in either a fore/aft direction or a lateral or side-to-side direction, as discussed below. For example, and as best seen with reference to FIGS. 2, 14 and 25, attachment 50 may include a pivot member 50a, which is attached to bracket 36 of deck 14 and which includes a generally spherical portion 50b. The generally spherical portion 50b may be pivotally received within a partial spherical collar member 50c at the outer end of the upper member 46b of boom 38, such that deck 14 is pivotable relative to boom 38 at attachment 50 in any direction via the ball and socket type of connection. Although shown and described as a ball member and partial spherical collar member, the multi-axis or universal attachment of the boom to the deck may comprise other attachment means, such as a coupling or attachment that is pivotable about a pair of generally orthogonal axes, without affecting the scope of the present invention.

[0055] The outer or lower member 46a of boom 38 is attached to pivot axle 47 at the rearward end or portion of frame 12 and is pivotable about a generally horizontal and laterally extending axis 52 at the rear end portion of frame 12. In the illustrated embodiment, boom 38 is fixedly attached to pivot axle 47, which is pivotally mounted to the rear portion of side members 22 of frame 12. For example, pivot axle 47 may be pivotally received within a bushing or bearing assembly or the like at a pair of openings 22a (FIGS. 5, 16 and 26) at the rear end portions of the side members 22 of frame 12. Boom 38 is pivoted about pivot axis 52 to raise and lower and pivot the deck 14 relative to frame 12. One or more actuators 54 (such as the two extendable and retractable hydraulic cylinders shown in the illustrated embodiment) may be pivotally attached to frame 12 and to outer member 46a of boom 38, and may be extendable and retractable to cause pivotal movement of boom 38 about pivot axis 52 to raise and lower the forward portion of deck 14. In the illustrated embodiment, a pair of actuators 54 are pivotally positioned at laterally opposite sides of boom 38.

[0056] Rearward supports 40 may be pivotally mounted at the rear end portion of frame 12 and may be pivotable about a generally horizontal and laterally extending axis 56 at one end

and pivotally mounted to slide members 44 at the other end. In the illustrated embodiment, and as best shown in FIGS. 5-7 and 16, rearward supports 40 may be attached to a pivotable lift arm 57 that is pivotally attached to a pair of mounting brackets 59. Mounting brackets 59 are attached to and extend from pivot axle 47, which, as discussed above, is pivotally mounted to the rear of frame 12. Lift arm 57 has one or more extensions 58 that extend outwardly from pivot axis 56 and that are pivotally connected to an end 60a of a respective actuator 60, such as a hydraulic cylinder or the like. Actuators 60 are connected at their other ends 60b to boom 38, such that extension and retraction of actuators 60 causes a corresponding movement of extension 58, which, in turn, causes pivotal movement of lift arm 57 and rearward supports 40 in unison about pivot axis 56. The mounting brackets 59 thus attach or mount lift arm 57 and supports 40 to frame 12 via pivot axle 47. Because mounting brackets are attached to pivot axle 47, pivotal movement of boom 38 and pivot axle 47 (such as via extension/retraction of actuators 54) causes a corresponding pivotal movement of brackets 59 and thus of lift arm 57 and supports 40 about pivot axis 52.

[0057] Lift arm 57 and both rearward supports 40 thus may be pivoted together or simultaneously between a generally upward position (as shown in FIGS. 1 and 8) and a generally horizontal position (as shown in FIG. 9) and a downwardly angled position (as shown in FIG. 19) relative to frame 12 to adjust the position and/or orientation of deck 14 relative to the frame. If deck 14 is not moved longitudinally (such as via extension and retraction of the boom 38) during pivotal movement of supports 40, then pivotal movement of rearward supports 40 causes a raising and lowering of the rear portion 14d of deck 14 while the slide members 44 slide along the rails 42 on the underside of deck 14. On the other hand, pivotal movement of supports 40 when boom 38 is correspondingly extended or retracted may cause raising or lowering of the rear portion of deck 14 without sliding of the slide members 44 along the rails 42 (because the deck may be moved longitudinally by the boom in a similar amount as the supports pivot), depending on the degree of extension and retraction of boom 38 and the pivotal movement of the supports 40. Also, pivotal movement of boom 38 about axis 52 causes a corresponding pivotal movement of mounting brackets 59 and thus of supports 40 about pivot axis 52. Such pivotal movement of the supports 40 may provide additional clearance between the deck and the frame when the deck is pivoted rearwardly and toward the ground (such as shown in FIG. 19). The deck thus may be raised generally vertically and/or may be moved longitudinally and/or may be tilted relative to the frame via adjustment of the boom and the rear supports.

[0058] The mounting brackets 59 position the lift arm and rearward supports rearward of the deck pivot axis 52, and, thus, may avoid potential interference between the deck and frame by enhancing the clearance between the deck and the frame when the deck is pivoted and moved rearward to lower the rear end of the deck toward and into contact with the ground (as shown in FIG. 19). However, although shown and described as being pivotally attached to the intermediate mounting bracket 59 extending from the pivot axle 47, the lift arm and/or rearward supports may be pivotally mounted directly to the rear portion of the frame, without affecting the scope of the present invention.

[0059] As best shown in FIGS. 5, 15-18, 21, 23 and 25, rearward supports 40 may comprise telescopic supports that include an outer or lower member 62a and an upper or inner member 62b, which is extendable and retractable relative to outer member 62a. As can be seen with reference to FIG. 5, inner member 62b of rearward support 40 is pivotally connected to a bracket 64 and is pivotable relative thereto about a generally horizontal and laterally extending pivot axis 64a. Bracket 64 is further connected at its opposite end to slide member 44 and is pivotable relative thereto about a generally longitudinally extending pivot axis 64b. Accordingly, the slide members 44 are attached to rearward supports via bracket 64 and are pivotable relative to the rearward supports about a pair of generally orthogonal pivot axes 64a, 64b to facilitate fore/aft tilting or pivoting of deck 14 relative to frame 12 and side to side tilting of deck 14 relative to frame 12. As shown in FIGS. 15-18, the telescopic rearward supports 40 may be extended and retracted via extension and retraction of a respective actuator 66 (such as a hydraulic cylinder or the like) positioned at least partially along and within the corresponding support 40. The actuators 66 may be independently and selectively extended and/or retracted to vertically adjust or raise or lower a respective side of the rear portion of deck 14, so as to tilt deck 14 toward one side or the other, while slide members 44 may pivot about longitudinally extending pivot axis 64b as the deck is tilted toward one side or the other relative to frame 12 (as can be readily seen with reference to FIGS. 20-24).

[0060] Accordingly, deck 14 may be adjusted relative to frame 12 to position the deck 14 at a desired height and angle relative to frame 12 and relative to the ground and/or the vehicle or aircraft to be loaded. In order to load trailer 10 from the ground, actuators 54 may extend to pivot boom 38 upwardly about pivot axis 52 to raise the front end of deck 14 such that deck 14 is tilted rearwardly toward the rear of the trailer and to pivot mounting brackets 59 to also pivot rearward supports 40 about pivot axis 52. Actuators 60 may be retracted to pivot rear supports 40 about pivot axis 56 to lower the upper ends of supports 40 and thus the rear end of deck 14 toward the ground. Actuator 48 of boom 38 may also be retracted to retract boom

38 and thus to move deck 14 rearwardly, whereby deck 14 may slide rearward relative to sliding members 44 until the ramped end 15 of deck 14 engages the ground (as shown in FIG. 19). When deck 14 is positioned in this orientation, the cargo or articles or the like may then be moved up the ramped portion of deck 14 and onto the deck to load the deck without having to raise or lift the articles or cargo upward and onto the deck. Once cargo is positioned at the rear of the deck, the conveyors may be activated to convey the cargo forward as desired.

[0061] When the deck is loaded, the actuators 54, 60, 48 may be actuated in the opposite direction to return the deck 14 to the transport position (such as shown in FIG. 9). After the trailer has been transported to the desired unloading area, such as adjacent to a targeted vehicle or aircraft or the like, deck 14 may be elevated to the desired level for unloading of trailer 10 and loading of the targeted vehicle. In order to raise deck 14 upward to the desired height, actuators 54 may again be extended to pivot boom 38 about pivot axis 52 to elevate the forward end of deck 14 above frame 12. The rear end of frame 14 may be raised by extension of actuators 60 to pivot rearward supports 40 about pivot axis 56. Sliding members 44 may slide along rails 42 as rearward supports 40 are pivoted toward the upright position (such as shown in FIG. 1).

[0062] When positioned at the desired height, which is determined by the extension/ retraction of actuators 54 and the extension/retraction of actuators 60, the deck 14 may be positioned generally at or near the targeted unloading area. The actuators 66 of rearward supports 40 may be independently extended or retracted to further vertically adjust the rearward portion of the deck and to level deck 14 or to otherwise tilt deck 14 to a desired angle relative to frame 12 and/or the targeted vehicle. The pivotable attachments of bracket 36 to boom member 46b and of slide members 44 to brackets 64 allows for pivotal movement or tilting of deck 14 about the longitudinal pivot axis 51b extending longitudinally along deck 14 to facilitate side to side tilting of the deck for aligning or leveling the deck. Likewise, the pivotal attachments of bracket 36 to boom member 46b and of bracket 64 to the upper end of support member 62b allows for pivoting of deck 14 about laterally extending pivot axes 51a, 64a to facilitate forward and aft tilting or pivoting or angling of deck 14 relative to frame 12.

[0063] The deck of the cargo trailer of the present invention thus may be adjusted to adjust the side to side tilt of the deck and/or the fore/aft tilt of the deck and/or the longitudinal position of the deck and/or the elevation of the deck relative to the frame via the substantially universally adjustable three point connection of the deck to the frame. The tilt or position or orientation or elevation of the deck may be adjusted irrespective of the initial position or

orientation of the deck relative to the frame. The actuators 54, 47, 60 and 66 may be independently actuated or extended/retracted to adjust the angle or tilt or position or orientation or elevation of deck 14 relative to frame 12 to achieve the desired result or position or orientation or elevation of deck 14, or the actuators may be controlled together, without affecting the scope of the present invention. The actuators or hydraulic cylinders may be extended or retracted via pressurized fluid from a pump powered or driven by an engine or motor. The motor, pump and control valves may be positioned on the trailer or on the towing vehicle, without affecting the scope of the present invention.

[0064] Cargo trailer 10 may be towed or moved by a towing vehicle 11 connected to a tow bar or draw bar or hitch member 70 of trailer 10. In order to enhance maneuverability and steering of cargo trailer 10, front axle assembly 18a may be pivotally mounted to the forward end of frame 12 and may be pivotable about a generally vertical pivot axis 72 relative to frame 12 to turn or steer cargo trailer 10. As best shown in FIGS. 26 and 28, hitch member 70 may be pivotally mounted to the front end of frame 12 and be pivotable about a second generally vertical pivot axis 74, which is positioned forwardly of pivot axis 72 for front axle assembly 18a. Hitch member 70 thus may be pivotable side to side relative to frame 12 about pivot axis 74 when pulled in either direction by the towing vehicle or when pivoted via extension or retraction of one or more steering actuators 76, such as hydraulic cylinders or the like, and discussed below.

[0065] As best shown in FIG. 28, hitch member 70 may include a guide pin or steering pin 78 extending downwardly therefrom and received in a slot 80a at a forward end of a base or plate or dolly 80 of axle assembly 18a. As can be seen with reference to FIGS. 26-28, as hitch member 70 is pivoted about pivot axis 74 toward one side or the other of frame 12, steering pin 78 engages and urges against plate 80 and causes a corresponding pivotal movement of plate 80 and thus of front axle assembly 18a about the other pivot axis 72. Pivot axis 74 is positioned generally forwardly of pivot axis 72, while pin 78 and slot 80a are likewise positioned forwardly of pivot axis 74. The cam follower/slot arrangement allows for movement of pin 78 along slot 80a as the pin 78 is arcuately moved through a different arcuate path than slot 80a of plate 80. The steering arrangement of trailer 10 thus provides enhanced steering of trailer 10 because, as hitch member 70 is pivoted toward one side or the other, the pin 78 functions to turn the front axle assembly 18a toward that side at some angle more suitable for the trailer to follow or track properly behind the tow vehicle or tractor. This is opposed to known trailer designs where the hitch member and the axle assembly pivot

about the same axis and the trailer does not track the tow vehicle but swings inside of the turning radius of the tow vehicle.

[0066] In the illustrated embodiment, hitch member 70 may be pivoted about pivot axis 74 via one or more actuators 76 that may extend and retract relative to one another to pivot hitch member toward one side or the other of frame 12. Such pivotal movement of the hitch member by the actuators mounted to the trailer frame allows for independent steering of the front axle assembly without having to wait for the towing vehicle to turn and pull at the hitch member to cause such steering. The steerable front axle assembly of the present invention thus provides for enhanced turning/steering of the trailer. Optionally, the actuators 76 may be substantially held or fixed or locked at a desired degree of extension to substantially lock the drawbar or hitch member 70 about axis 74, such as when hitch member 70 is in a substantially straight ahead position, to further enhance the turning of the trailer, such as when the front and rear wheels and tires are raised above the ground, as discussed below. Optionally, the actuators 76 may be extended and retracted to move or swing the trailer while the tow vehicle is stationary so that the rear of the trailer may be moved to align with the airplane or loading dock for loading or unloading cargo from or onto the trailer.

[0067] Hitch member 70 may include a base portion 70a pivotally attached to frame 12 and a hitching or attaching portion 70b pivotally attached to base portion 70a and pivotable about a generally horizontal pivot axis 71, such that a towing end of hitching portion 70b may be vertically adjusted relative to base portion 70a and frame 12. As shown in FIG. 28, an actuator 82 may be pivotally connected between base portion 70a and hitching portion 70b, and may be extended and retracted to pivot hitching portion 70b about pivot axis 71 to vertically adjust the hitching or attaching end 70c of hitch member 70 relative to frame 12. Such a controlled lifting mechanism for the hitch member may substantially ease attachment of the hitch member to the towing vehicle. Also, similar to actuator 76, discussed above, actuator 82 may be substantially fixed or locked in a desired degree of extension to substantially lock or fix the position of hitch member 70 about pivot axis 71, to further enhance the steering or turning of the trailer.

[0068] Optionally, the rear axle assembly 18b may also be steerable or turnable relative to frame 12 via a steering system or mechanism 80. For example, and with reference to FIG. 27, steering mechanism 80 may comprise a linkage or connecting member 82 that extends from front axle assembly 18a to rear axle assembly 18b and is operable to steer or turn the rear wheels and tires or the rear axle 19 in a direction generally opposite to the turning or steering direction of the front wheels or tires. Linkage 82 may extend longitudinally along a

side of the frame 12 and may cause rotation of a cross member or linkage 84 via a connecting link 83a when linkage 82 is moved longitudinally by turning of the front wheels or axle assembly. Cross member 84 is connected to another linkage assembly 86, such that pivotal movement of cross member 84 causes turning of the tires 16a and wheels 16b of the rear axle assembly 18b relative to the axle 19.

[0069] As can be seen in FIGS. 4 and 27, pivotable linkages 86 may be pivotally attached to a bracket 87 attached to the rear axle 19 and may be pivotable about a generally vertical pivot axis 86a at bracket 87. Rotation of cross member 84 pushes or pulls at the ends 86b of the generally L-shaped linkages 86 to cause a corresponding pivotal movement of linkages 86 about pivot axis 86a to move a steering rod 88 to steer the rear tires 16a and wheels 16b relative to the axle 19 in one direction or the other. As shown in FIG. 27, longitudinally extending connecting linkage 82 may be supported at or near the central region of the frame 12 via a pivotable link or arm 83b that allows fore/aft or longitudinal movement of connecting linkage or linkages 82 via pivotal movement of the arm 83b when the forward linkage is moved by steering of the front axle assembly.

[0070] For example, and with reference to FIG. 27, when front axle assembly 18a is turned toward the left side of the frame 12, connecting linkage 82 is moved rearwardly along the side of the frame 12, which causes a corresponding clockwise rotation of cross member or linkage 84. The rotation of cross member 84 pulls at linkages 86 to cause pivotal movement of linkages 86 about pivot axis 86a, which further causes movement of the steering rod 88 toward the right side to turn the rear wheels toward the right side or toward the opposite direction of the front wheels. Turning in the other direction is accomplished in a similar manner, except that linkage 82 pulls forwardly to rotate cross member 84 in the counter-clockwise direction, which pushes at linkage 86 to move steering rod 88 to the left to steer the rear wheels to the left.

[0071] Although shown and described as a steering mechanism with mechanical linkages, other steering systems or mechanisms may be implemented to steer the rear wheels of the trailer, without affecting the scope of the present invention. Optionally, for example, the steering system or mechanism may comprise other steering means, such as a master/slave hydraulic steering system or the like, without affecting the scope of the present invention. Optionally, the rear axle assembly may comprise a cam follower/slot arrangement or mechanism to steer the rear axle assembly similar to the manner described above with respect to the front axle assembly.

[0072] The hitching arrangement and steering system of the cargo trailer of the present invention facilitates enhanced turning or steering of the trailer and, thus, enhanced maneuverability of the trailer. As shown in FIG. 29, the steering system of the present invention allows the trailer 10 to substantially follow or track the path of the towing vehicle 11 via the dual axle steering and via the steering mechanism of the front axle assembly. The trailer thus may generally follow the path of the towing vehicle and may not substantially cut the corners as the vehicle is driven around a curve or turn. The steering system of the present invention also provides an enhanced or tighter turning radius over conventional trailers.

[0073] As can be seen with reference to FIGS. 12, 15-18 and 27, the axles 19 of axle assemblies 18a-c may be mounted to pivotable mounting arms 90, which may be pivotally mounted to frame 12. Mounting arms may pivot about a respective generally horizontal axis 92 to allow the axles 19 and tires 16a and wheels 16b to move up and down relative to frame 12 as the trailer travels along the road or path. The suspension system may include shock absorbers or pneumatic shocks or drums 94 at the ends 90a of arms 90 opposite to the pivot axes 92 to dampen the movement of the axles about the pivot axes 92. As can be seen in FIGS. 12, 15, 16, 21, 23 and 27, at least some of the axle assemblies may include individual braking systems or devices or mechanisms 96, such as pneumatically powered brakes or the like, which are operable to brake the wheels of the respective axle assemblies as desired.

[0074] Optionally, the axle assemblies 18 of trailer 10 may be vertically adjustable axle assemblies, such that the axles (and wheels and tires attached thereto) may be selectively vertically adjustable relative to one other and relative to the frame 12 of the cargo trailer 10. For example, the axles 19 and pivotable support arms 90 of each axle assembly 18 may be selectively pivoted about their respective pivot axis 92 via an actuator or the like. When pivot arms 90 are pivoted about the respective pivot axis 92, the respective axle and wheels attached thereto may be raised or lowered relative to frame 12. Such pivotal movement of the pivot arms 90 may be provided by one or more actuators, such as pneumatic actuators or the like, mounted between frame 12 and ends 90a of pivot arms 90 opposite to the pivot axis 92 (such as where the pneumatic shock absorbers are in the illustrated embodiment). Accordingly, the axle assemblies may be selectively raised and lowered relative to the other axle assemblies to provide enhanced maneuverability and/or traction and/or economy of the trailer during use in various environments or surfaces.

[0075] For example, during typical substantially level road surface driving, the center axle assemblies 18c may be selectively raised upwardly relative to frame 12 and the front and rear axle assemblies 18a, 18b, such that the trailer 10 is supported on the road by the tires, wheels

and axles of the front and rear axle assemblies 18a, 18b. Such an arrangement may provide a more economical means of travel along substantially level terrain where the additional axle assemblies may not be required. Optionally, the front and rear axle assemblies 18a, 18b may be selectively raised upwardly relative to the center axle assemblies 18c and relative to frame 12, such that the trailer is supported by the tires, wheels and axles of the center or central axle assemblies 18c. Such an arrangement may be desired in highly uneven terrain, such as off road type terrain and the like, to allow for a greater degree of tilting of the trailer as it is moved over the terrain. The support of the trailer by the two central axle assemblies may also provide a tight or smaller turning radius or pivotal movement of the trailer relative to the ground. For example, the actuator or actuators 76 (and/or actuator 82) may be substantially locked to lock or hold the hitch member 70 in a desired orientation, such as in a substantially straight ahead position, whereby the trailer may be backed up or reversed in a normal manner (if the hitch member were not lockable in a desired orientation, special training and skill may be needed to properly steer the trailer when traveling in reverse), and may provide a tight turning radius due to the ability of the trailer to substantially pivot about the central axle assemblies. Optionally, the tires of the central axle assemblies may have a tread or track (not shown) wrapped or reeved around the tires to provide enhanced traction in areas where such traction may be desired.

[0076] Therefore, the present invention provides a cargo trailer or vehicle, and, more particularly, a cargo handling adverse terrain trailer (CHATT) or the like. The cargo trailer has a deck that is pivotally and vertically and longitudinally adjustable to assist in loading the trailer and positioning the deck at a desired level for loading and/or unloading a vehicle, such as an aircraft or the like. The deck of the cargo trailer may be pivoted about a longitudinally extending axis and/or one or more laterally extending axes to position the deck at a desired level and height and orientation relative to the frame of the trailer. The pivotal adjustment of the deck about either axis may be accomplished irrespective of the initial orientation or position of the deck relative to the trailer, in order to enhance the overall adjustability of the trailer. The deck of the trailer may pivot and move toward and into contact with the ground to ease loading and unloading of the trailer.

[0077] The cargo trailer of the present invention may also provide for enhanced turning or steering of the front wheels of the trailer via a hitch mechanism that provides for pivotal movement of the hitch member and pivotal movement of the front axle assembly about different pivot axes. Side-to-side movement of the hitch member thus may exert a turning force on the front axle assembly to provide for a sharper turning radius of the trailer.

Optionally, the trailer of the present invention may provide for steering of the rear wheels to further enhance the maneuverability of the trailer. Also, the axle assemblies may optionally be selectively vertically adjustable relative to the frame of the trailer to provide for enhanced performance of the trailer in various driving conditions and driving surfaces. Trailer control while backing up may be greatly enhanced by the ability to selectively lock the hitch member in a desired orientation relative to the axle assembly, while forward tracking of the trailer behind the vehicle is also greatly enhanced when the hitch member is unlocked and allowed to pivot about the vertical pivot axis.

[0078] Changes and modifications to the specifically described embodiments may be carried out without departing from the principles of the present invention, which is intended to be limited only by the scope of the appended claims, as interpreted according to the principles of patent law.